

XLII.—*Additional Notes on the Form of the Bones in the Sternum of very young Tortoises, and their Development.*  
By Dr. J. E. GRAY, F.R.S. &c.

[Plate XII.]

THE British Museum having received some young tortoises from North America, presented by the Smithsonian Institution, I have been induced to examine the form of the bones of the their sterna—and also the bones of the sterna of other young specimens that are in the Museum, some of which have been received since my former paper.

As many of these specimens were in spirit before they were examined, it is necessary to observe that if the sternum is looked at as it is taken out of spirit, even when perfectly cleaned inside, it appears to be a uniform opaque disk, and the form of the bones cannot be observed even when held up to the light—until it is dried, when the cartilaginous part becomes transparent, showing the opaque bones; and it becomes again opaque when again placed in proof spirit.

I have had great difficulty in obtaining young specimens for the purpose of determining the development of the bones of the sternum, and have thought myself very fortunate when I have obtained one or two of a species; and I thought that this arose from collectors thinking that young specimens would not be so much esteemed by Museum-directors as the others. But Prof. Agassiz, who lives and has collected in the country where tortoises are abundant, observes that the young *Emydes* live almost exclusively in water, much more so than their parents; and though the young are naturally in much larger numbers than the adults, they are still so rarely found that they are almost unknown to zoologists. He observes:—"For example, *Emys insculpta* is so common in the neighbourhood of Lancaster that I have collected more than a hundred specimens in one afternoon, and yet I have never been able to obtain one of the first year, though a whole school of young men were called in to search. Prof. Baird has found the same difficulty in obtaining young *Emys rugosa* for me, and though he offered a high price for them he could not obtain more than a single specimen of the first year; and yet this species is so common that, in the season, hundreds are daily brought to the market of Washington." ('Contributions,' i. p. 294.)

I have also been able to examine the sternum of the very young of two genera of land-tortoises that I had not before been able to examine and therefore to add them to my previous paper.

The bones of the sternum of a specimen of *Homopus signatus* (Pl. XII. fig. 1), which is  $1\frac{1}{2}$  inch long, are very little developed. The front pair are very short; the front and hind lateral pairs are separated by a broad space, and form only a margin to the outer side of the front and hinder lobes of the sternum, the hinder pair the smallest; the anal pair very small. The gular plates are very short, band-like, and transverse; the postgular plates are quadrangular, diverging; the pectoral plates triangular.

The sternum of the young *Kinixys erosa* (fig. 2) is like that of the other land-tortoises; but the bones, except the anal pair of a specimen about 2 inches long, are very narrow, only margining the front and hind lobes. The odd bone very small. The anal pair entirely covered both above and below by a hard horny sheath. The front lobe with a narrow, and the sides of the hind lobe with a broader (expanded) margin, the latter covered above and below with the horny sheath of the plates, which is thicker in these parts than usual.

In the younger specimens of Steganopodes (or Freshwater Terrapins) the front pair of bones is distinct, furnished with a lanceolate odd bone on their inner edge. The front lateral pair are more or less expanded, extending more or less across the shell, with a dentated inner edge and more or less straight hinder edge. The hinder lateral pair diverge backwards, and have a more or less dilated lobe on the truncated inner edge; and the hinder pair are smaller, with a lobe on the middle or towards the end of the inner edge, which is dentated on its inner edge, leaving a small oval space on each side of the odd bone; a large oblong or rhombic space between the hinder end of the front lateral and the front edge of the lobes of the hinder lateral bone, and a more or less square cavity between the hinder edge of the lobe of the hinder lateral and the lobe of the hinder pair. These spaces are diminished by the increase of the size of the bones; the central one, between the processes of the front and hinder lateral bones, is closed last.

The sternal bones of the young *Geoemyda spinosa* (fig. 3) 2 inches long form only a ring round the sternum, and they are very like those of *Rhinoclemmys*; but the front lateral bone is broader and larger, more dilated at the upper front end near the odd bone, where it is divided into many narrow lobes, of which a few of the lower are separated from the others by a narrow space, and form a separate group.

The sternal bones of *Geoemyda grandis* (fig. 4)  $2\frac{1}{4}$  inches long (although the adult is a much larger species) are very like those of *G. spinosa*: but the front pair are broader; the odd bone is longer and more slender, and the front lateral pair

are furnished on the inner side with a lobe directed towards the centre of the sternum and torn at the end. The hinder lateral pair have a small conical prominence on the middle of the inner side: indeed they are very like those of *Notochelys platynota*; but the lobe on the inner side is much smaller and less marked. The young sternum of this species is intermediate between the form that is found in *Geoemyda spinosa* and that which is common to the species of *Emys*.

The sterna of the young specimens of *Bellia* (fig. 10) and *Damonìa* (figs. 11 & 12) are much thicker and more solid than the sterna of the young of *Malaclemmys*, *Pseudemys* (fig. 9), *Chrysemys* (fig. 7), and *Trachemys* (fig. 8) of America, and *Emys* (fig. 6), *Emmenia* (fig. 5), and *Platysternon* (fig. 13) of Europe and Asia. The skin that fills up the vacancies between the bones is much thicker, and so opaque when dried, that the sterna might be regarded as solid; but the cavities leave a sunken space visible on the outside, and they are easily pierced with a pin, showing that there is only a dried cartilaginous skin, though so thick and opaque that it looks like bone.

The development of the bones, and the changes in form which they undergo, in the Freshwater Turtles or Steganopodes may be arranged under four heads.

I. In the more terrestrial animals the bones of the sternum in the young specimens are narrow, and form a marginal ring round the circumference of the sternum, leaving a large oblong central unossified space, which eventually becomes filled up, as in the genera *Cyclemys* in the Cistudinidæ, and *Geoemyda* and *Rhinoclemmys* in the Emydæ.

The sternum of the young *Geoemyda grandis* (fig. 4) has rudimentary lobes diverging from the inner side of the anterior and posterior lateral bones, forming a passage to the next form; but this may be the way in which the central space is filled up, and is only a matter of growth.

II. In the genera which have the second form all the bones of the circumference of the sternum are broader, and the front and hinder lateral pairs and the anal pair have a more or less broad lobe on the inner side, tending towards the central suture, dividing the central space into three parts: the front one is generally the smallest, and divided in the middle by the central odd bone, the middle one the largest and broadest, and the hinder one smaller and generally longer than broad. These processes enlarge, and unite and solidify in the sternum—as in *Notochelys* of the Cistudinidæ, in *Chrysemys* of America, *Emys* and *Emmenia* of the Mediterranean region, *Bellia* and *Damonìa* (from Asia) of the family Malaclemmydæ, *Pseudemys*

and *Trachemys* of the family Pseudemydæ (which are confined to America), and *Kachuga* of the family Bataguridæ (which are confined to Asia, and have the internal lobes of the sternal bones in the young specimens broader than in any of the preceding genera). In all the above genera the lobe of the internal edge of the anal pair of bones is near the anal end of that bone, except in the genera *Pseudemys* and *Batagur*, where it is much nearer the fore end of the internal edge, leaving a broad vacant space, so that very young specimens appear to have three vacant spaces behind the hinder edge of the front pair of lateral bones.

The bones of the sternum of the young *Platysternon* are intermediate in form between these and the next division; that is to say, the front and hinder lateral bones are dilated into a triangle, dentated on the inner edge, and the anal pair have a broad lobe on the front part of the inner edge, as in *Kachuga* and *Pseudemys*.

III. The third form differs from the second in the lateral pairs of bones and the anal bones of the young specimens being dilated, ovate or triangular, leaving a space on each side of the odd bone, a large, more or less rhombic, space between the front and hinder lateral pairs, and a smaller rhombic space between the hinder edge of the hinder lateral pair and the front edge of the anal pair—as in *Lutremys* and *Cuora* (fig. 14) (both from the Old World) in the Cistudinidæ, and *Malaclemmys* (from North America) in the Malaclemmydæ. The young *Pelomedusa*, the type of the African family Pelomedusidæ, among the Pleuroderes, has the sternum very like that of *Malaclemmys*.

IV. The fourth form, which appears to be peculiar to the family Chelydradæ, has the four pairs of bones of which it is composed more or less dilated, leaving in the very young state an elongate central vacant space, which is generally pervaded in front by a very long slender odd bone; this bone is entirely wanting in the most developed types of the family called the Trap Tortoises, as the genera *Kinosternon* and *Swanka*. Unfortunately I have not been able to examine the sterna of several genera of this group: indeed I have only been able to see the sternum in a small well-developed specimen of *Kinosternon*. A very young specimen of *Swanka* has never occurred to me; and I am not aware that it has ever been seen or described by any American or other zoologist. I have figured the outside of the sternum of a very young *Kinosternon pennsylvanicum* in my former paper ('Annals,' 1873, xi. pl. 5. fig. 6).

EXPLANATION OF PLATE XII.

- Fig. 1.* Homopus signatus.  
*Fig. 2.* Kinixys erosa.  
*Fig. 3.* Geoemyda spinosa.  
*Fig. 4.* Geoemyda grandis.  
*Fig. 5.* Emmenia Grayi.  
*Fig. 6.* Emys Fraseri.  
*Fig. 7.* Chrysemys picta.  
*Fig. 8.* Trachemys Holbrookii.  
*Fig. 9.* Pseudemys concinna.  
*Fig. 10.* Bellia crassicolis.  
*Fig. 11.* Damonina macrocephala.  
*Fig. 12.* Damonina Reevesii.  
*Fig. 13.* Platysternon peguense.  
*Fig. 14.* Cuora amboinensis.

XLIII.—*On Spontaneous Division in the Echinodermata and other Radiata.* By Dr. C. F. LÜTKEN\*.

IT is only in a few specimens of *Ophiothela isidicola*, sp. n.† (from Formosa), that I have found the six arms equal or nearly so: in most individuals of moderate size the three arms of one side are larger than those of the opposite side; and in this respect we find all possible intermediate stages, from specimens with three arms well developed and three scarcely perceptible, to others in which the difference is insignificant. Moreover we find nearly as many specimens having only three arms and the corresponding half of the disk (as if they had been cut with a knife into two equal parts) as of completely developed individuals with six equal arms. There is no doubt that a division has taken place, at least in the case of those which have only three arms, or three large and three small ones, and that the halves produced by this division have the power of replacing the missing half both of the disk and arms. It is only with regard to the minority which are furnished with six equal arms, and in which the two halves of the disk are equally developed, that there can be any doubt; for although the greater part of the individuals of this species may be destined to undergo division, we must not conclude from this that all are so.

Whether the division is repeated several times in this Ophiurid I cannot decide with certainty; but the series of specimens

\* Translated and slightly abridged by W. S. Dallas, F.L.S., from a paper entitled "Ophiuridarum novarum vel miris cognitaram descriptiones nonnullæ," published in the Oversigt over det K. Dansk. Vid. Selsk. Förhandl. 1872, pp. 108-158, French summary, pp. 30-54.

† The Latin characters of the new species will be given at the conclusion of this paper.